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Forest
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Subject: Effects Analysis for Insects and Diseases for Coconino Fire Use Plan

To: Liz Blake

As requested this letter documents our analysis of the effects of varying fire regimes on several insects and diseases affecting forests on the Coconino National Forest. Effects are described by forest vegetation type in both matrix and narrative form.

Mixed Conifer/Spruce Fir

Agent	No Fire	Low Fire	Moderate Fire	High Fire
Root Diseases	+/-	NC	+	-
Stem Decays	+/-	+/-	+	-
Dwarf Mistletoes	+	-	-	-
Western Spruce budworm	+	NC	-	-
Bark Beetles	+	+	+/-	+/-

No Change (NC) Increase (+) Decrease (-) Variable (+/-)

Low fire refers to the range of fire intensities managed for in the mixed conifer and spruce fir vegetation types.

No fire means no managed fire, High fire refers to the catastrophic alternative to no fire.

Narrative:

Diseases: Root disease is prevalent in the mixed conifer and spruce fir vegetation types, caused by several fungal pathogens with host species preferences. In general, spread of root disease is by root-to-root contact, or fungus-to-root contact, and dead trees and stumps enhance the buildup and spread of disease. The effects of fire on root disease are variable. Any fire may consume stumps and snags when they are not protected. However, the consumption of well-decayed stumps and snags would have little impact on the incidence of root disease since disease would have previously spread to live trees. Consumption of recently killed trees would lower root disease potential to the site. Low intensity fire would cause little mortality of large trees so the incidence of root disease is not expected to increase under this fire regime. Moderate and high intensity fires could result in mortality, which may increase incidence of root disease unless the fire is so severe that the host is wiped out.

Stem decay causing fungi are also prevalent in these vegetation types. Stem decay would likely increase following any fire since the wounding of trees creates an entry court. However, the amount of wounding and decay is significantly less from a low intensity fire compared to a high intensity fire. In recreation areas, hazard problems caused by decay following fire scarring should be suspected and remedied.



Douglas fir dwarf mistletoe is common. Fire can decrease infection within individual trees by killing lower infected branches. Fire can also kill dwarf mistletoe infected trees. Douglas fir dwarf mistletoe causes large dense witches' brooms that often break from trees during heavy snow loading and accumulate at the base of trees. This material is extremely flammable and promotes crown fire. Some infected trees can survive even high intensity fires and infect the next generation.

Insects: Western spruce budworm is the most important defoliating insect affecting the mixed conifer vegetation type in the Southwest. Hosts include white fir, Douglas fir, Engelmann spruce and subalpine fir. This insect is found on the San Francisco Peaks though outbreaks have not been as severe to date here as in other parts of the southwest. A number of factors are thought to affect susceptibility to budworm, including species composition (proportion of host species), stand density (greater density favors budworm), structure (multistoried host stands favor the insect), tree and stand vigor (fast growing trees and stands not as susceptible), and stand maturity (susceptibility increases as trees and stands mature). In other parts of the southwest, particularly northern New Mexico, it has been suggested that a variety of historic land uses including extensive logging, fires (associated with settlement), and grazing followed by fire exclusion have resulted in creation of much more homogeneous and susceptible forests composed of dense multistoried host species. These forest conditions are in turn thought to be associated with changes in budworm outbreak patterns, including greater synchronicity of outbreaks and more severe outbreaks. While not studied on the Coconino National Forest, similar changes have occurred here. In the future, absence of fire will allow stands to continue to increase in age and density, while decreasing in growth. All of these factors favor western spruce budworm. Low intensity fire would probably maintain the status quo. Both moderate and high fire intensities would change forest conditions enough that susceptibility would be reduced.

Several bark beetle species are present in the mixed conifer and spruce fir types including spruce beetle, western balsam bark beetle, Douglas-fir beetle, and fir engraver. All are host specific and favor dense mature stands. High and moderate intensity fires could change stand conditions enough to reduce susceptibility over time to the agents, however in the case of other agents the fire itself can create conditions that allow populations to increase to outbreak levels. Douglas-fir beetle in particular has been known to build up in fire killed and injured timber and spread into adjacent green trees. Absence of fire and low intensity fire would not change existing forest conditions that are generally very favorable for outbreak development for several of these species.

Aspen

Agent	No Fire	Low fire	Moderate Fire	High Fire
Root Diseases	+	+	-	-
Decays	+	+	-	-
Cankers	+	+	+	+

No Change (NC) Increase (+) Decrease (-) Variable (+/-)

Low and Moderate Fire refer to the range of fire intensities managed for in the aspen vegetation type

Narrative:

Diseases: Aspen is a relatively short-lived species, and the incidence of decay and canker increase with stand age. However, susceptibility of a stand or clone to a particular disease is based on genetics, so while one clone is susceptible to ganoderma root disease another may be more susceptible to black canker. Although aspen forests do not burn readily, aspen trees are extremely sensitive to fire. Very light fires can kill aspen or create basal scars leading to heart rot. Weakened trees may also be more susceptible to root disease. Moderate and high intensity fires can kill most or all of the overstory and stimulate suckering. Root and stem decay decreases with the death of the host. Canker incidence initially spikes upward since one canker disease, caused by *Cytospora sp.*, is associated with burned trees.

Ponderosa Pine

Agent	No Fire	Low fire	Moderate Fire	High Fire
Dwarf Mistletoes	+	-	+/-	-
Decays	+/-	+	+	-
Bark Beetles	+	+	-	-

No Change (NC) Increase (+) Decrease (-) Variable (+/-)

Low, and Moderate refer to the range of fire intensities managed for in the ponderosa pine vegetation type. High fire is the catastrophic alternative to no fire

Narrative:

Diseases: Ponderosa pine dwarf mistletoe is the most common disease in the Region. Historically, wildfires have been the most important single factor governing the distribution and abundance of dwarf mistletoes. Because infested trees have highly flammable witches' brooms and lower live crowns, a larger proportion of the crown of an infested tree is likely to be scorched than the crown of a healthy tree. With equal amounts of crown scorch in the 40 to 90% range, heavily infected trees have a lot lower probability of survival compared to uninfected trees. Wildfires (high intensity) are frequently effective in limiting dwarf mistletoe populations because trees usually return to burned sites much faster than the parasite returns. However, spotty fires can leave scattered, live, infected trees that not only regenerate the stand but also re-infest it.

Ponderosa pine is a very resinous species that is more resistant to decay than most species in mixed conifer vegetation types. Heart rot is associated with mature trees (e.g. greater than 150 years in age), and some species of decay fungi are only found in virgin stands with trees 300+ years of age and basal scarring from fire. Stem decay would likely increase following any fire since the wounding of trees creates an entry court. However, the amount of wounding and decay is significantly less from a low intensity fire compared to a moderate intensity fire. High intensity fires would likely kill the host and therefore reduce the incidence of disease. In recreation areas, basal scarring and associated decay should be checked for creation of hazard trees.

Insects: Several species of bark beetles affect ponderosa pine on the Coconino National Forest, with the most important being the western pine beetle and pine engraver beetles, *Ips* spp. These agents are among the most important mortality agents affecting ponderosa pine. Outbreaks of the western pine beetle are mostly associated with relatively dense mature pine forests and often precipitated by drought. Pine engraver beetles prefer to breed in fresh pine debris but under certain conditions will attack living trees, typically smaller diameter trees or tops of larger trees. As with western pine beetle, dense stands are vulnerable. Historically frequent fire regimes in the ponderosa pine forests may have limited bark beetle populations by maintaining stands in a fairly open condition. In the absence of fire or other stand disturbance, susceptibility to bark beetles will increase over time. Low fire intensities will not change stand characteristics enough to reduce susceptibility in stands that are already dense. Moderate and high fire intensities would cause mortality and depending on the distribution of that mortality likely reduce susceptibility to these agents.

Pinyon-Juniper

Agent	No fire	Low fire	Moderate Fire	High Fire
Dwarf Mistletoe	+	+/-	+/-	-
True Mistletoe	+	+/-	+/-	-
Bark beetles	+	+	-	-

Narrative:

Diseases: Like other mistletoes, the most limiting factor in the distribution of *A. divaricatum*, the dwarf mistletoe of pinyon pine, and *Phoradendron juniperinum*, the true mistletoe of juniper, is fire. Areas devoid of mistletoe infection are often those with a history of a burn. Although fire is expected to behave differently in these stands since pinyon and juniper trees are shorter and the form is more rounded than that of other conifers, the outcome will be the same for high intensity fires.

Insects: The most important insect affecting pinyon juniper woodlands is the pinyon ips. This is another bark beetle species and is closely related to the species affecting ponderosa pine. The relationships between fire and this insect are not documented but suspected to be similar to other pine bark beetles.

If you have any questions concerning this letter, or require additional information, please don't hesitate to contact either Mary Lou Fairweather or myself. Mary Lou can be reached via email at mfairweather@fs.fed.us or via phone at (520) 556-2075. Jill can be reached via email at jwilson@fs.fed.us or via phone at (520) 556-2074.

/s/ Jill L. Wilson

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